DIRECTIONAL DRILL BIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to rotary drill bits for drilling or coring holes in subsurface formations and, more particularly, to drill bits that adapted to be steered, as in directional drilling.

2. Description of Related Art

Around the world an increasing percentage of wells that are drilled in subterranean earthen formations in the pursuit of oil and gas are being drilled with non-linear trajectories. This type of drilling is commonly called "directional drilling", and requires great skill in causing the rotating bit to drill in a certain direction. To aid in this type of drilling, special bottom hole assemblies are used that have drill collars of certain weights and lengths, as well as stabilizers. One critical item of equipment that can dramatically influence the trajectory of the wellbore being drilled is the bit itself. Bit designers have long tried to design their bits to have predictable drilling characteristics so that the drilling operator at the earth's surface can more easily manipulate the trajectory of the wellbore.

Roller cone and drag-type drill bits have certain characteristics that make them more or less desirable for directional drilling. One such characteristic is a relatively short length, which means that it has a relatively shorter fulcrum length, that enables the drill bit to be offset or "steered" in a particular direction. A shorter drill bit has been found to be more "steerable" over a longer drill bit. It has been desired to design drill bits of short length for directional drilling purposes; however, due to the extreme forces that a drill bit is subjected to while drilling, the size and amount of structural material used in a drill bit cannot be reduced. There is a need for a drill bit that has the desired size and amount of structural material, yet has a relatively shortened length to enhance its directional drilling capabilities.

SUMMARY OF THE INVENTION

The present invention has been contemplated to overcome the foregoing deficiencies and meet the above described needs. In particular, the present invention comprises a rotary drill bit for drilling subsurface formations with a bit body with a shank extending therefrom for connection to a drill string. Breaker slots are formed in the drill bit at the intersection of the bit body with the shank, such as in the weld between the crown portion of the bit body and the shank. The breaker slots being located at the intersection permit the overall length of the drill bit to be reduced, thereby, creating a drill bit that can more easily be steered in directional drilling applications.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional elevational view of a drag type drill bit of the Prior Art, showing breaker slots spaced from the intersection of the bit body and the shank.

FIG. **2** is a cross-sectional elevational view of one preferred embodiment of a drill bit of the present invention, showing breaker slots at the intersection of the bit body and the shank.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As has been briefly described above, the present invention is a drill bit for use in drilling subsurface formations, especially useful for directional drilling applications. The present invention can be used with roller cone drill bits, as well as drag-type drill bits; however, for the purposes of the present discussion, it will be assumed that the present invention is a drag-type drill bit. Typical drag-type drill bits that the present invention can be used with are commonly referred to as natural diamond, TSP, and PDC drill bits.

To aid in the understanding of the present invention, reference is made to a Prior Art drag-type drill bit **10** shown in FIG. **1**. The drill bit **10** has a crown portion **12** machined from metal, usually steel, which may be hard faced. Alternatively the crown portion **12**, or a part thereof, may be molded from matrix material using a powder metallurgy process. The methods of manufacturing drill bits of this general type are well known in the art and will not be described in detail. Not shown in FIG. **1** are the diamond cutting elements that extend from the crown portion **12** to engage and remove the earthen material during the drilling process. A threaded steel shank **14** extends from the bit body **10** for interconnection to a drill string, as is well known to those skilled in the art.

At least two parallel breaker slots or flats **16** are machined or formed at a location on the shank **14** spaced from an intersection **18** formed by a beveled annular surface **20** on an upper end of the crown portion **12** and a beveled annular surface **22** on a lower end of the shank **14**. This intersection **18** usually has an inclusive angle of about 40 degrees, and is filled with weld material **24**, as is well known to those skilled in the art.

When the drill bit **10** is to be threadedly connected to a drill string, relatively large tongs or a breaker plate (not shown) are slipped into the breaker slots **16**, and the drill bit **10** is rotated with respect to the drill string. As shown in FIG. **1**, the breaker slots **16** are located on the shank **14** at a location spaced from the intersection **18**. This is desired to not place unnecessary stress or strain on the weld material **24**, that could cause the destructive separation of the crown **12** from the shank **14** while drilling. For example, in a standard 6½ inch diameter PDC drill bit, the distance from the lowermost tip of the crown **12** to a location on the shank **14** immediately beyond the slots **16**, can be about 8 inches to about 8¾ inches, with the distance between the intersection **18** and the center of the slots **16** being about 3 inches.

As described above, it is desired to reduce the overall length of the drill bit as much as possible so that the drill bit can be more easily steered in directional drilling applications. The inventors hereof have found that a drill bit can be designed of significantly less length by forming the breaker slots at or immediately adjacent the intersection of the crown portion and the shank portion without sacrificing structural integrity. As shown in FIG. **2**, a drill bit **30** has a crown portion **32** machined from metal, usually steel, which may be hard faced. Alternatively the crown portion **32**, or a part thereof, may be molded from matrix material using a powder metallurgy process. The methods of manufacturing drill bits of this general type are well known in the art and will not be described in detail. A threaded steel shank **34** extends from the bit body **30** for interconnection to a drill string, as is well known to those skilled in the art.

At least two parallel breaker slots or flats **36** are machined or formed at a location on the shank **34** at or immediately adjacent to an intersection **38** formed by a beveled annular surface **40** on an upper end of the crown portion **32** and a beveled annular surface **42** on a lower end of the shank **34**. This intersection **38** as before has an inclusive angle of about 40 degrees, and is filled with weld material **44**, as is well known to those skilled in the art. The breaker slots **36** can be formed entirely in the crown portion **32** adjacent to the intersection **38**, entirely in the shank portion **34** adjacent to the intersection, partially in the crown **32** and the weld **44**, partially in the shank **34** and the weld **44**, or preferably entirely in the weld **44**.